

The claimed invention is:

1. An apparatus for generating an image using an algorithm, the algorithm having a plurality
5 of tasks for determining the level of energy emanating from a source located within a mass,
the apparatus comprising:

memory configured to store information defining a trace, the trace defining energy
levels recorded at a sensor, the amplitude of the trace at one or more given
instants of time being the sum of energy received from two or more sources;
10 and
a data processor in electrical communication with the memory, the data processor
configured to simultaneously execute two or more tasks of the algorithm and
determine the level of energy emanating from each source.

15 2. The apparatus of claim 1 wherein:

the algorithm is formed from a plurality of tasks; and
the data processor includes a plurality of execution units, each execution unit formed
from a circuit for executing at least one of the tasks.

3. The apparatus of claim 1 wherein:

the memory is further configured to store data defining at least a portion of one or more traces;

the plurality of execution units are arranged into one or more pipelines and are

5 arranged to receive data from the memory into the one or more pipelines; and
all of the tasks forming the algorithm are executed on a single clock cycle when the pipeline is fully loaded with data.

4. The apparatus of claim 2 wherein the data processor includes:

10 a travel time processor, the travel time processor having a plurality of execution units
arranged to calculate the travel time for the energy between the source in the mass and the sensor; and

a trace processor, in electrical communication with the travel time processor, the trace
processor having a plurality of execution units arranged to determine the level
15 of energy emanating from each source and recorded at the sensor.

5. The apparatus of claim 4 wherein the travel time includes the combined travel time of energy from a shot position to the source and from the source to the sensor.

20 6. The apparatus of claim 4 wherein the travel time includes only the travel time of energy from the source to the sensor.

7. The apparatus of claim 4 wherein the travel time processor includes an interpolator formed from a plurality of execution units arranged to process first and second travel times corresponding to first and second sources, respectively, and interpolate an intermediate travel time from a third source positioned intermediate to the first and second sources.

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8. The apparatus of claim 4, wherein the travel time processor includes cache, memory, and an interpolator, the memory configured to store a plurality of predetermined travel times forming a coarse grid of travel times, the plurality of travel times including first, second, third, and fourth travel times corresponding to first, second, third, fourth sources, respectively, the interpolator being formed from a plurality of execution units arranged to:

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receive the first and second predetermined travel times from memory, interpolate a first intermediate travel time for a first intermediate source positioned between the first and second sources, and cache the first intermediate travel time;

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receive the third and fourth predetermined travel times from memory, interpolate a second intermediate travel time for a second intermediate source positioned between the third and fourth sources, and cache the second intermediate travel time; and

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receive the first and second intermediate travel times from cache, interpolate a third intermediate travel time for a third intermediate source positioned between the first and second intermediate sources.

9. The apparatus of claim 4 wherein the data processor is further configured to generate an image from the level of energy emanating from each source and recorded at the sensor.

10. An apparatus for generating an image using an algorithm, the algorithm having a plurality of tasks for determining the level of energy emanating from a source located within a mass, the apparatus comprising:

- 5 memory configured to store information defining a trace, the trace defining energy levels recorded at a sensor, the amplitude of the trace at one or more given instants of time being the sum of energy received from two or more sources; and
- 10 a data processor in electrical communication with the memory, the data processor having a plurality of pipelined execution units, each execution unit configured to execute a task of the algorithm and determine the level of energy emanating from each source.

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11. An apparatus for generating an image using an algorithm, the algorithm having a plurality of tasks for determining the level of energy emanating from a source located within a mass, the apparatus comprising:

memory configured to store information defining a trace, the trace defining energy

levels recorded at a sensor, the amplitude of the trace at one or more given
instants of time being the sum of energy received from two or more sources;
and

a data processor in electrical communication with the memory, the data processor

having a plurality of execution units, each execution unit configured to execute
a task of the algorithm and determine the level of energy emanating from each
source.

12. An apparatus for generating an image using an algorithm, the algorithm having a plurality of tasks for determining the level of energy emanating from a source located within a mass, the apparatus comprising:

memory configured to store information defining a trace, the trace defining energy

levels recorded at a sensor, the amplitude of the trace at one or more given
instants of time being the sum of energy received from two or more sources;
and

a data processor in electrical communication with the memory, the data processor

configured to execute all tasks of the algorithm and determine the energy level
emanating from each source.

13. An apparatus for generating an image of a mass, a plurality of sources being located in the mass, the apparatus comprising:

memory configured to store information defining energy levels recorded at a sensor,

the energy levels emanating from one or more of the sources;

a data processor having circuitry; and

an algorithm having a plurality of tasks for determining the level of energy emanating from each source and recorded at the sensor, the algorithm being implemented in the circuitry.

14. The apparatus of claim 13 wherein the circuitry is arranged to form a plurality of execution units, the execution units being organized into one or more pipelines.

15. The apparatus of claim 13 wherein substantially all of the algorithm is implemented in circuitry.

16. The apparatus of claim 13 wherein the entire algorithm is implemented in circuitry.

17. The apparatus of claim 16 wherein the algorithm is placed and routed in circuitry.

18. A method of manufacturing a circuit for generating an image of a mass, a plurality of sources being located in the mass wherein energy is emanating from the sources, the image being generated from energy levels recorded at a sensor, the method comprising:

creating a gate-level netlist, the netlist corresponding to an algorithm having a

5 plurality of tasks for determining the energy level emanating from each source

and recorded at the sensor; and

placing and routing the netlist in circuitry.

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10 19. The method of claim 18 wherein placing and routing the netlist in circuitry includes placing and routing the net list in reconfigurable circuitry.

20. The method of claim 18 wherein placing and routing the netlist in circuitry includes placing and routing the net list in hardwired circuitry.

15 21. The method of claim 18 wherein placing and routing the netlist in circuitry includes placing and routing the net list in silicon material.

22. An apparatus for interpolating travel times for energy between a source in a mass and a sensor, the apparatus comprising:

cache;

memory configured to store a plurality of travel times forming a coarse grid of travel

5 times, the plurality of travel times including first, second, third, and fourth travel times corresponding to first, second, third, and fourth sources, respectively; and

an interpolator formed from a plurality of execution units arranged to receive the first

and second predetermined travel times from memory, interpolate a first

10 intermediate travel time for a first intermediate source positioned between the first and second sources, and cache the first intermediate travel time; receive

the third and fourth predetermined travel times from memory, interpolate a

second intermediate travel time for a second intermediate source positioned

between the third and fourth sources, and cache the second intermediate travel

15 time; and receive the first and second intermediate travel times from cache,

interpolate a third intermediate travel time for a third intermediate source

positioned between the first and second intermediate sources.

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23. An apparatus for interpolating travel times for energy between a source in a mass and a sensor, the apparatus comprising an interpolator formed from a plurality of execution units arranged to:

process first and second travel times corresponding to first and second sources,

5 respectively; and

interpolate an intermediate travel time from a third source positioned intermediate to the first and second sources.

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